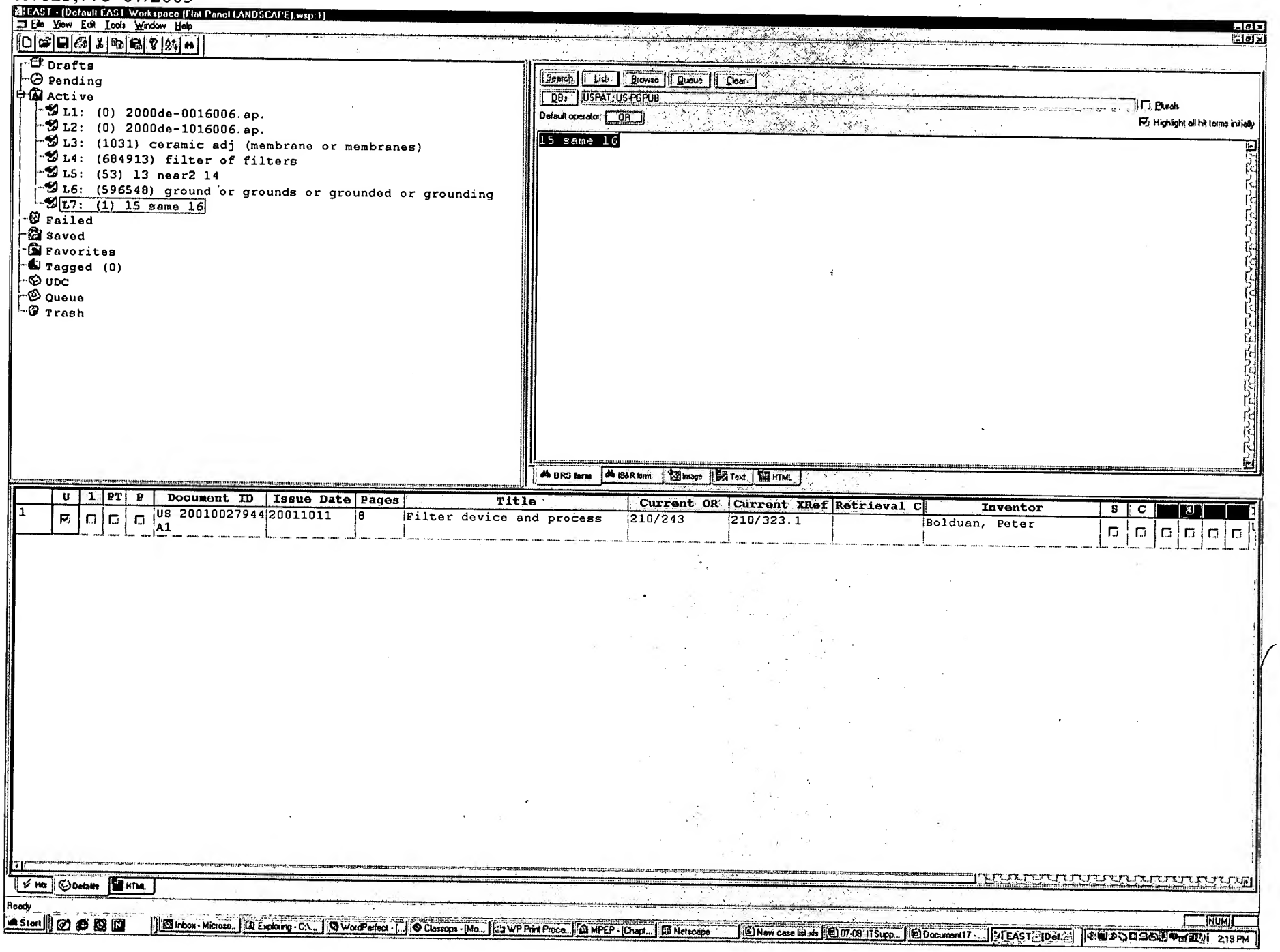
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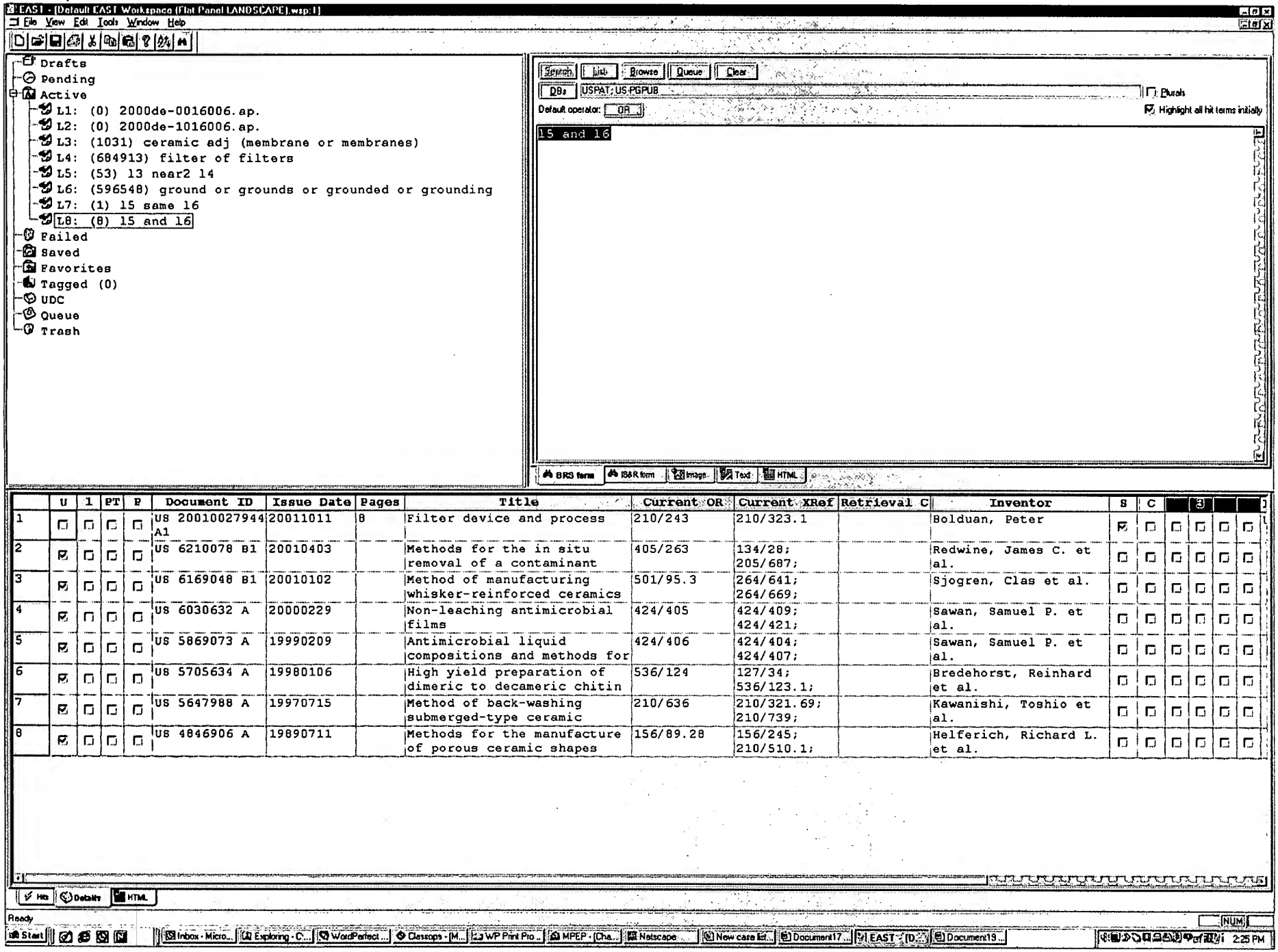

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1	☐	☐	☐	☐	US 20010027944 A1	20011011	8	Filter device and process	210/243	210/323.1		Bolduan, Peter	☑	☐	☐	☐	☐	☐
2	☑	☐	☐	☐	US 6210078 B1	20010403		Methods for the in situ removal of a contaminant	405/263	134/28; 205/687;		Redwine, James C. et al.	☐	☐	☐	☐	☐	☐
3	☑	☐	☐	☐	US 6169048 B1	20010102		Method of manufacturing whisker-reinforced ceramics	501/95.3	264/641; 264/669;		Sjogren, Clas et al.	☐	☐	☐	☐	☐	☐
4	☑	☐	☐	☐	US 6030632 A	20000229		Non-leaching antimicrobial films	424/405	424/409; 424/421;		Sawan, Samuel P. et al.	☐	☐	☐	☐	☐	☐
5	☑	☐	☐	☐	US 5869073 A	19990209		Antimicrobial liquid compositions and methods for	424/406	424/404; 424/407;		Sawan, Samuel P. et al.	☐	☐	☐	☐	☐	☐
6	☑	☐	☐	☐	US 5705634 A	19980106		High yield preparation of dimeric to decameric chitin	536/124	127/34; 536/123.1;		Bredehorst, Reinhard et al.	☐	☐	☐	☐	☐	☐
7	☑	☐	☐	☐	US 5647988 A	19970715		Method of back-washing submerged-type ceramic	210/636	210/321.69; 210/739;		Kawanishi, Toshio et al.	☐	☐	☐	☐	☐	☐
8	☑	☐	☐	☐	US 4846906 A	19890711		Methods for the manufacture of porous ceramic shapes	156/89.28	156/245; 210/510.1;		Helferich, Richard L. et al.	☐	☐	☐	☐	☐	☐

EAST Browser - L0: (0) 5 and 6 | US 5647988 A | Tag: 5 | Doc: 6/0 (SORTED) | Format : KWIC

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2	US 6169048 B1	6				☑				USPAT
3	US 6030632 A	23				☑				USPAT
4	US 5869073 A	22				☑				USPAT
5	US 5705634 A	17				☑				USPAT
6	US 5647988 A	11				☑				USPAT
7	US 4846906 A	6				☑				USPAT

Brief Summary Text - BSTX (15):

Further, in the method for back-washing a submerged-type ceramic membrane separation apparatus according to the present invention, it is preferable to rinse the ceramic membrane filters with the filtrate or with a solution of a reducing agent after the chemical washing.

Brief Summary Text - BSTX (16):

With this feature of the back-washing method, the chemical agent remaining in the ceramic membrane filters and in the filtrate passages can be forced out of the ceramic membrane filters by rinsing the membrane filters with the filtrate after the chemical washing. Where an oxidizing agent is used as the chemical agent, the oxidizing agent can be inactivated by rinsing with the reducing agent after the chemical washing. This prevents such a chemical agent as oxidizing agent in high concentration from coming out of the apparatus along with the filtrate when a filtering operation is resumed.

Detailed Description Text - DETX (2):

With reference to the accompanying drawings, the present invention will be hereinafter described by way of examples. The water treatment systems illustrated in FIGS. 1 and 3 to 5 are used, for example, for water purification of river water, lake water, ground water and the like, activated sludge treatment process for treating sewage water, night soil, industrial waste water and the like, concentration of sludge, separation of bacteria, and desalination of sea water. The submerged-type ceramic membrane separation apparatus separates turbidity, activated sludge, and flock coagulated with such coagulants as poly-(aluminium chloride) (PAC), aluminium sulfate, ferric chloride or poly-(ferric sulfate).

Detailed Description Text - DETX (5):

The membrane separation apparatus 3 comprises a plurality of stacked membrane modules each having a plurality of tubular ceramic membrane filters which are connected to a filtrate suction pipe line 6 for communicating with the inside of the ceramic membrane filters, i.e., filtrate passages. A control valve 7 and a suction pump 8 are disposed intermediate the filtrate suction pipe line 6 which is led to a filtrate tank 9 provided outside the water treatment vessel 1.

Detailed Description Text - DETX (39):

Though, in the foregoing EXAMPLEs, each chemical solution is prepared in the back-washing water feeding pipe line by supplying the required chemical agent to the filtrate, the chemical solution may, of course, be preliminarily prepared in the chemical agent vessel and fed into the membrane separation apparatus for the chemical washing. Further, the back-washing method of the present invention is applicable to membrane separation apparatus of flat-membrane type and an internal-pressure type, though the membrane separation apparatus of an external-pressure type having tubular ceramic membrane filters is used in the foregoing EXAMPLEs of the present invention.

Claims Text - CLTX (2):

forcibly supplying filtrate from the apparatus and a chemical agent, separately, to filtrate passages in ceramic membrane filters to wash the ceramic membrane filters with the filtrate during a water washing and to wash the ceramic membrane filters with the chemical agent during a chemical washing.

United States Patent [19]

Kawanishi et al.

[11] **Patent Number: 5,647,988**

[45] **Date of Patent: Jul. 15, 1997**

[54] **METHOD OF BACK-WASHING SUBMERGED-TYPE CERAMIC MEMBRANE SEPARATION APPARATUS**

[75] Inventors: **Toshio Kawanishi; Shigeki Yokoyama; Katsuro Ishihara; Yoshihisa Narukami; Masahiko Shioyama; Mikiharu Tokushima; Toshiya Ozaki, all of Osaka, Japan**

[73] Assignee: **Kubota Corporation, Japan**

[21] Appl. No.: **349,014**

[22] Filed: **Dec. 2, 1994**

[30] **Foreign Application Priority Data**

May 30, 1994 [JP] Japan 6-115783

[51] Int. Cl.[6] B01D 62/02

[52] U.S. Cl. 210/636; 210/791; 210/739; 210/741; 210/321.69

[58] Field of Search 210/636, 739, 210/741, 791, 321.69, 106, 108; 134/10

[56] **References Cited**

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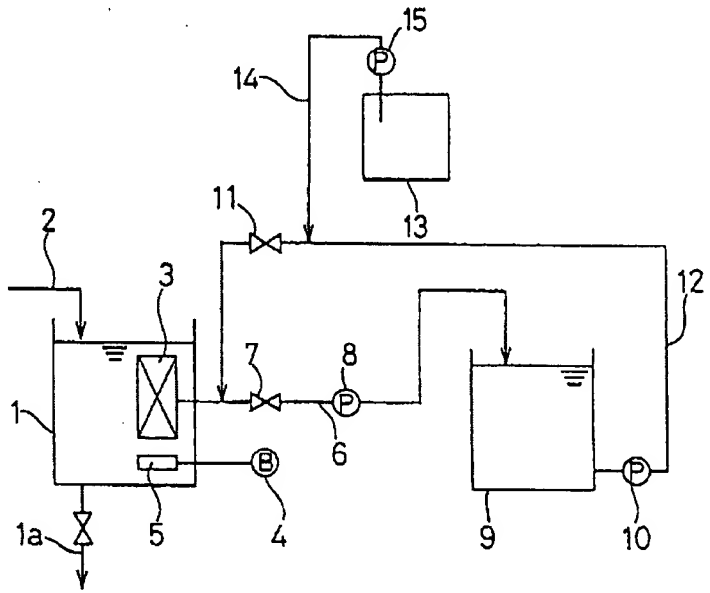
Primary Examiner—Robert Popovics

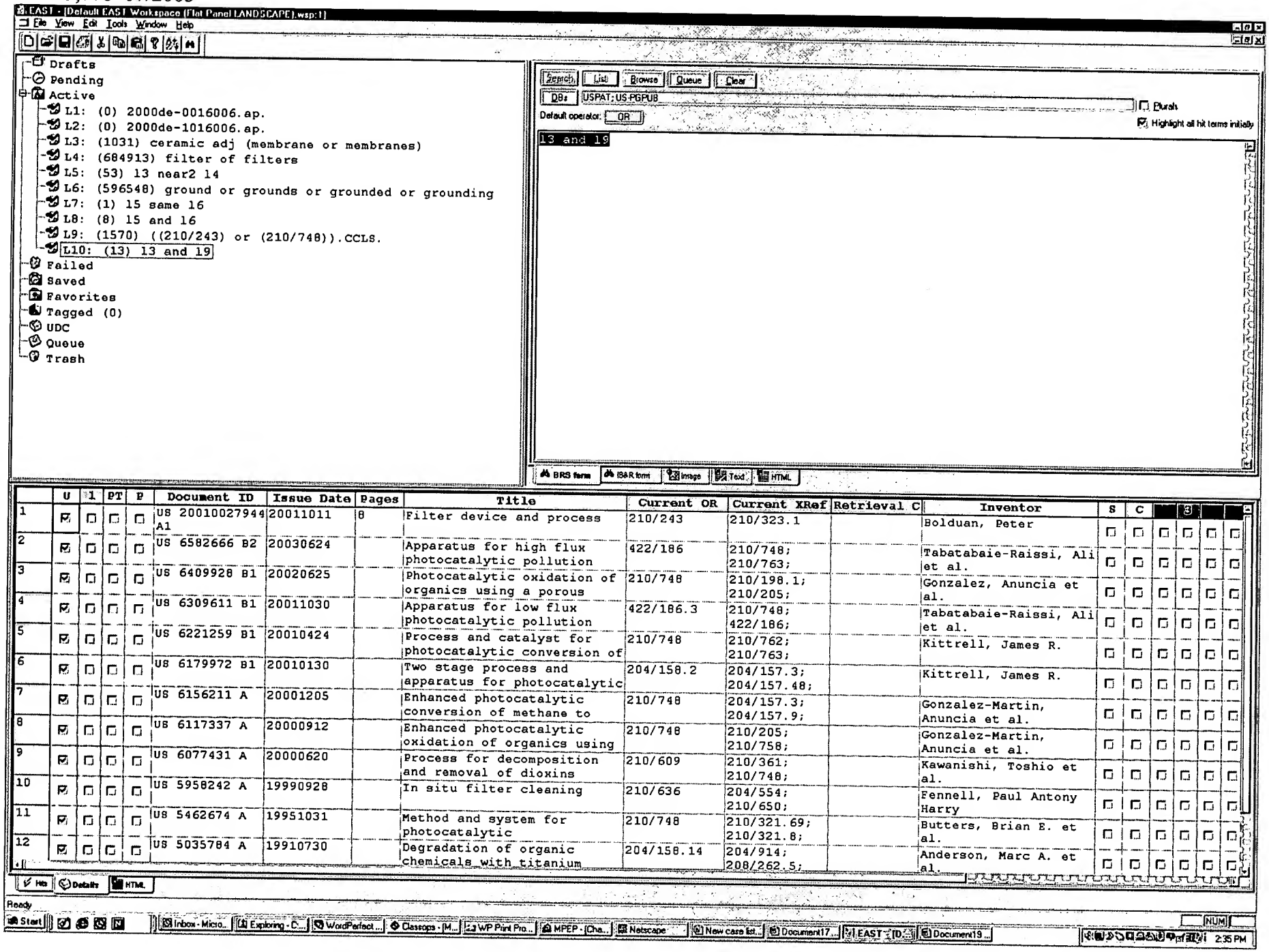
Attorney, Agent, or Firm—D. Peter Hochberg; Mark Kusner

[57] **ABSTRACT**

A method for back-washing a submerged-type ceramic membrane separation apparatus is provided in which filtrate once removed from the apparatus and a chemical agent are forcibly supplied to filtrate passages in ceramic membrane filters to wash the ceramic membrane filters with the filtrate and with the chemical agent, wherein the water washing and chemical washing are carried out at a predetermined frequency ratio and for a predetermined time period, or wherein the frequency and time period of the chemical washing are determined on the basis of a transmembrane pressure difference, suction pressure or filtrate flux observed during a filtering operation performed by the membrane separation apparatus. This method makes it possible to avoid an excessive chemical washing, and to reduce the amounts of water and chemical agent and the time required for the chemical washing.

7 Claims, 5 Drawing Sheets





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1	☑	☐	☐	☐	US 20010027944 A1	20011011	8	Filter device and process	210/243	210/323.1		Bolduan, Peter	☐	☐	☐
2	☑	☐	☐	☐	US 6582666 B2	20030624		Apparatus for high flux photocatalytic pollution	422/186	210/748; 210/763;		Tabatabaie-Raissi, Ali et al.	☐	☐	☐
3	☑	☐	☐	☐	US 6409928 B1	20020625		Photocatalytic oxidation of organics using a porous	210/748	210/198.1; 210/205;		Gonzalez, Anuncia et al.	☐	☐	☐
4	☑	☐	☐	☐	US 6309611 B1	20011030		Apparatus for low flux photocatalytic pollution	422/186.3	210/748; 422/186;		Tabatabaie-Raissi, Ali et al.	☐	☐	☐
5	☑	☐	☐	☐	US 6221259 B1	20010424		Process and catalyst for photocatalytic conversion of	210/748	210/762; 210/763;		Kittrell, James R.	☐	☐	☐
6	☑	☐	☐	☐	US 6179972 B1	20010130		Two stage process and apparatus for photocatalytic	204/158.2	204/157.3; 204/157.48;		Kittrell, James R.	☐	☐	☐
7	☑	☐	☐	☐	US 6156211 A	20001205		Enhanced photocatalytic conversion of methane to	210/748	204/157.3; 204/157.9;		Gonzalez-Martin, Anuncia et al.	☐	☐	☐
8	☑	☐	☐	☐	US 6117337 A	20000912		Enhanced photocatalytic oxidation of organics using	210/748	210/205; 210/758;		Gonzalez-Martin, Anuncia et al.	☐	☐	☐
9	☑	☐	☐	☐	US 6077431 A	20000620		Process for decomposition and removal of dioxins	210/609	210/361; 210/748;		Kawanishi, Toshio et al.	☐	☐	☐
10	☑	☐	☐	☐	US 5958242 A	19990928		In situ filter cleaning	210/636	204/554; 210/650;		Fennell, Paul Antony Harry	☐	☐	☐
11	☑	☐	☐	☐	US 5462674 A	19951031		Method and system for photocatalytic	210/748	210/321.69; 210/321.8;		Butters, Brian E. et al.	☐	☐	☐
12	☑	☐	☐	☐	US 5035784 A	19910730		Degradation of organic chemicals with titanium	204/158.14	204/914; 208/262.5;		Anderson, Marc A. et al.	☐	☐	☐

EAST Browser - L10: (13) 3 and 9 | US 5958242 A | Tag: 5 | Doc: 9/13 (SORTED) | Format: KWIC

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5	US 6179972 B1	8											USPAT
6	US 6156211 A	16											USPAT
7	US 6117337 A	16											USPAT
8	US 6077431 A	12											USPAT
9	US 5958242 A	5											USPAT

US-PAT-NO: 5958242

DOCUMENT-IDENTIFIER: US 5958242 A

TITLE: In situ filter cleaning

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Brief Summary Text - BSTX (2):
A method for cleaning an electrically-conducting filter is described in GB 2 160 545 B which enables fouling to be removed from the filter in situ. In this method an electrochemical cell is established comprising the filter as a first electrode, a counter electrode, and the process liquid as electrolyte. At intervals during the filtration process a potential difference is applied briefly between the two electrodes, so as to generate at the filter a gaseous product which may be in the form of microbubbles, and which cleans the filter. For example a current of 500-3000 A m.sup.-2 of membrane might be applied for 1-5 seconds periodically between 4-15 times an hour. The potential difference is typically applied such that the filter itself is cathodic, to minimise its corrosion, and the filter may be a metallic microporous membrane, or a conducting ceramic membrane. A similar process is described in EP 0 380 266 A, in which the filter may be a porous layer for example of sintered zirconia incorporating a metal mesh, or may be a porous layer superimposed on such a metal mesh. The counter electrode may be of platinised titanium, or as described in EP 0 474 365 A it may be of low chromium stainless steel. It will be appreciated that during the applications of the cleaning potential difference there is considerable electrical power consumption.

Current US Cross Reference Classification - CCXR (3):
210/748

United States Patent [19]

Fennell

[11] **Patent Number: 5,958,242**

[45] **Date of Patent: Sep. 28, 1999**

[54] **IN SITU FILTER CLEANING**

[75] Inventor: **Paul Antony Harry Fennell**, Didcot, United Kingdom

[73] Assignee: **AEA Technology PLC**, Didcot, United Kingdom

[21] Appl. No.: 08/763,092

[22] Filed: Dec. 10, 1996

[30] Foreign Application Priority Data

Dec. 14, 1995 [GB] United Kingdom 95 255583

[51] Int. Cl.[6] B01D 15/04; B01D 61/00

[52] U.S. Cl. 210/636; 210/650; 210/748; 204/554

[58] Field of Search 204/554, 660, 204/665; 210/636, 500.36, 500.38, 650, 500.25, 500.42, 748; 55/131, 498

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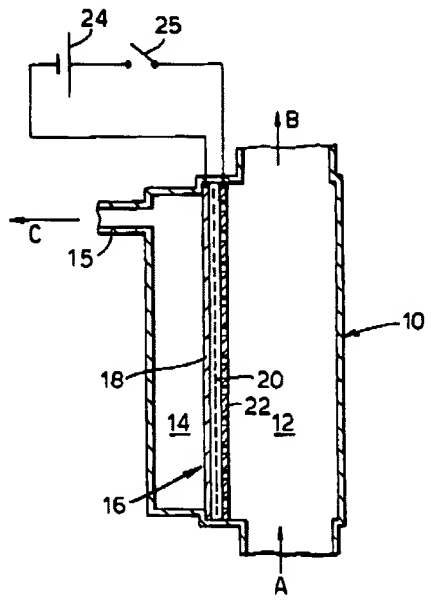
WO 92/21433	12/1992	WIPO .

Primary Examiner—Ana Fortuna
Attorney, Agent, or Firm—William H. Holt

[57] **ABSTRACT**

A filter which can be cleaned in situ consists of a filter membrane (33), and fluid permeable electrodes (34, 35). The membrane may be one of the electrodes, or may be electrically non-conducting but integral with or in contact with one of the electrodes (34). The electrodes (34, 35) are separated from each other only by a fluid permeable electrically insulating sheet. This sheet may be less than 1 mm thick, and may be the filter membrane (33). The filter is cleaned by periodic brief applications of electric current between the electrodes (34, 35) so that gas is generated electrolytically, and the close spacing of the electrodes (34, 35) reduces the electric power required.

14 Claims, 1 Drawing Sheet



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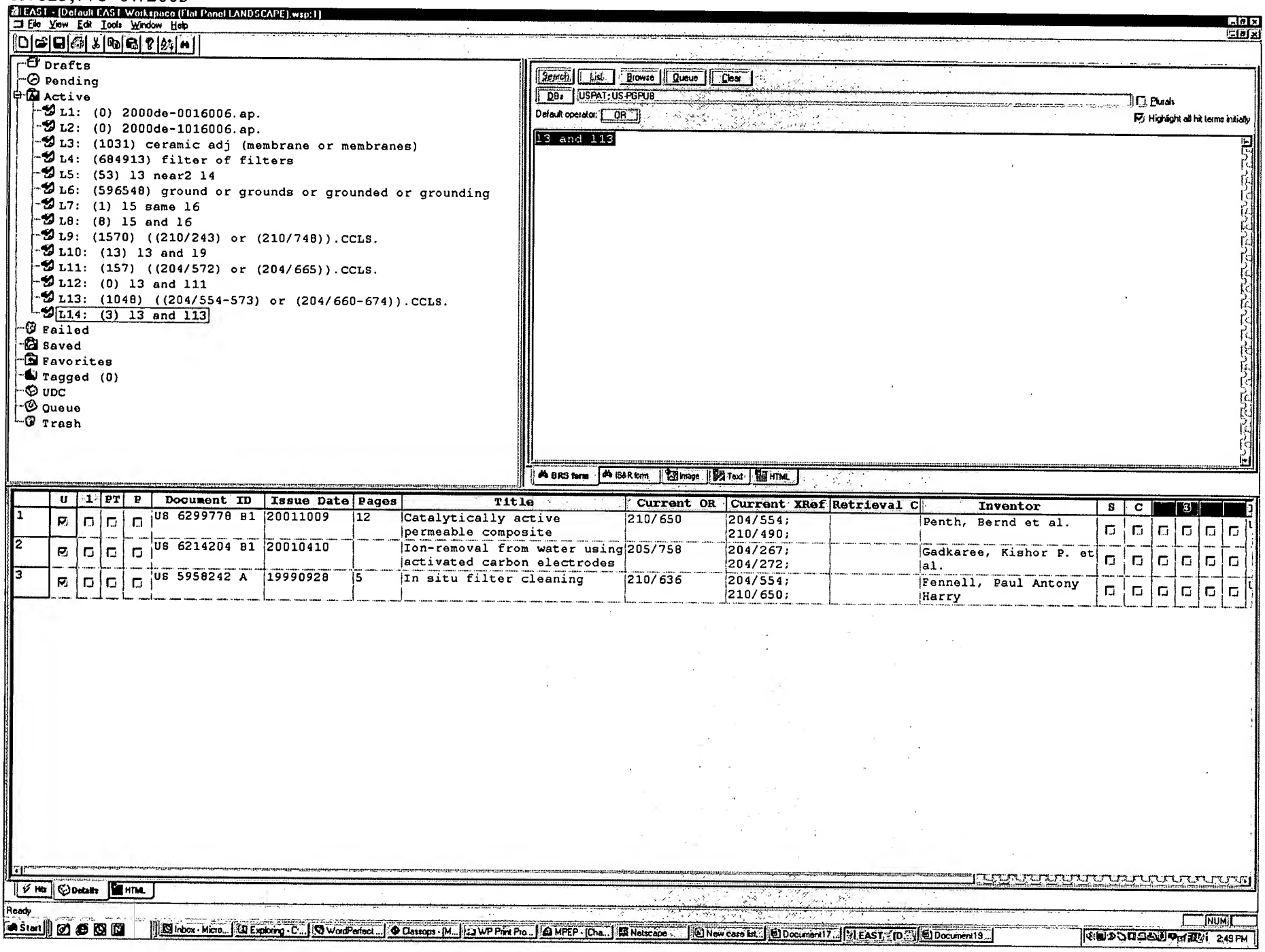

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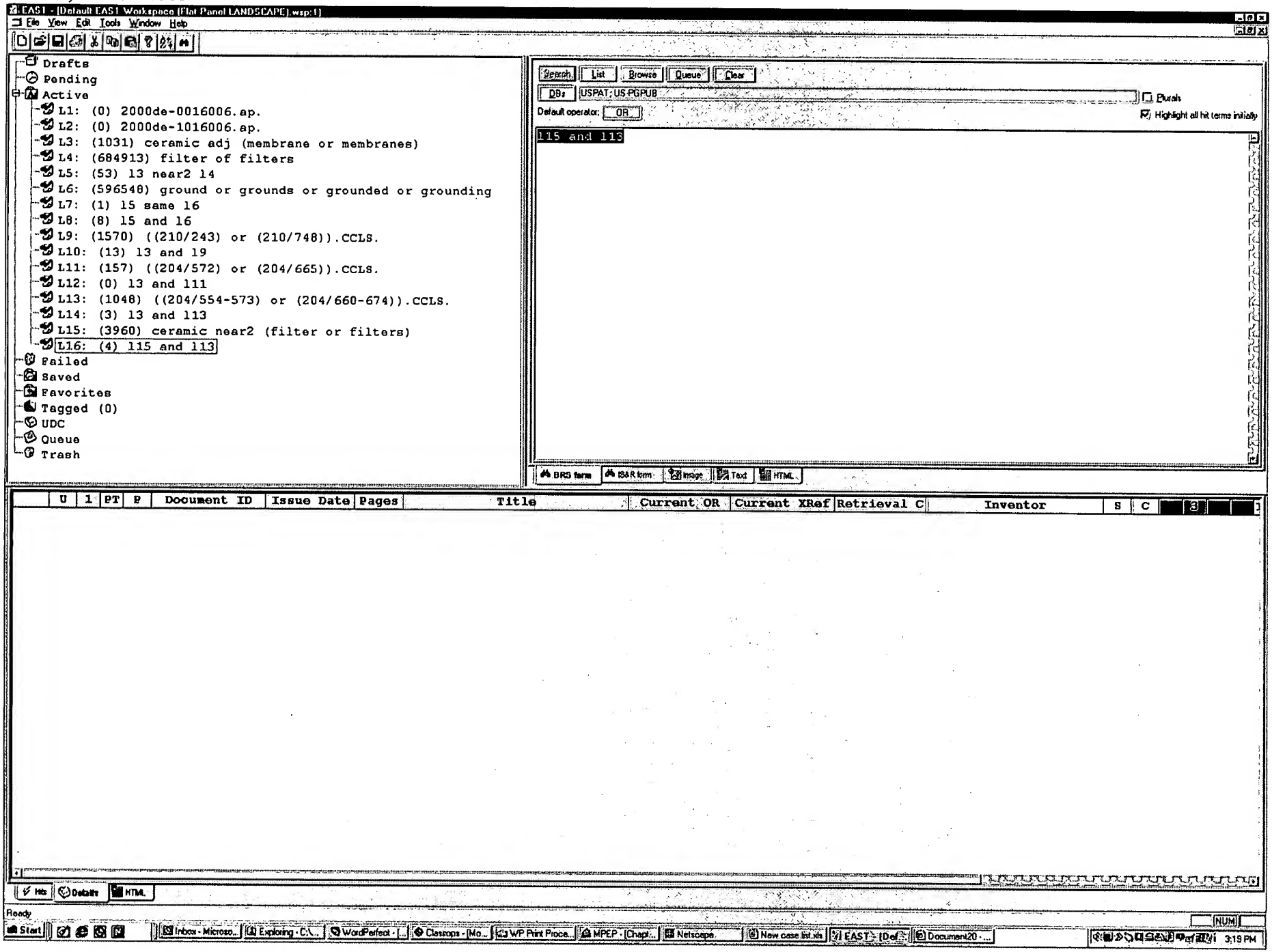
1	☑	☐	☐	☐	US 6299778 B1	20011009	12	Catalytically active permeable composite	210/650	204/554; 210/490;		Penth, Bernd et al.	☐	☐	☐	☐	☐	☐
2	☑	☐	☐	☐	US 6214204 B1	20010410		Ion-removal from water using activated carbon electrodes	205/758	204/267; 204/272;		Gadkaree, Kishor P. et al.	☐	☐	☐	☐	☐	☐
3	☑	☐	☐	☐	US 5958242 A	19990928	5	In situ filter cleaning	210/636	204/554; 210/650;		Pennell, Paul Antony Harry	☐	☐	☐	☐	☐	☐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1	US 6495052 B1	9								USPAT
2	US 6325916 B1	27								USPAT
3	US 6036840 A	28								USPAT
4	US 5597479 A	17								USPAT

US-PAT-NO: 5597479

DOCUMENT-IDENTIFIER: US 5597479 A

TITLE: Electro-coalescence/magnetic separation (ECMS) system and components for removal of contaminants from water streams, including desalinization

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Detailed Description Text - DETX (5):

The water streams leaving the turbulators 14, having been subjected to electric and magnetic fields as discussed in Ser. No. 08/200,749, then enter a primary/secondary filter unit 18. As discussed in detail below, filter unit 18 comprises a tank containing a large bed of finely-divided glass and/or ceramic polarizable filter media. This material serves to physically filter and/or magnetically separate coagulated materials, particularly when polarized by application of an electric current thereto. The water is drained from the base of the primary/secondary filter unit 18 by an underdrain so that the media remains in the tank while the water stream is removed therefrom. The underdrain includes elements having an electric potential applied thereto to polarize the media.

Current US Cross Reference Classification - CCXR (3):
204/663

Current US Cross Reference Classification - CCXR (4):
204/664

Current US Cross Reference Classification - CCXR (5):
204/665

United States Patent [19]

Johnson

[11] **Patent Number: 5,597,479**

[45] **Date of Patent: Jan. 28, 1997**

[54] **ELECTRO-COALESCENCE/MAGNETIC SEPARATION (ECMS) SYSTEM AND COMPONENTS FOR REMOVAL OF CONTAMINANTS FROM WATER STREAMS, INCLUDING DESALINIZATION**

[75] Inventor: **Dennis E. J. Johnson**, Aurora, Ill.

[73] Assignee: **Aqua-Ion Systems, Inc.**, Littleton, Colo.

[21] Appl. No.: **377,620**

[22] Filed: **Jan. 25, 1995**

[51] Int. Cl.[6] C02F 1/463

[52] U.S. Cl. **210/192**; 210/199; 210/202; 210/203; 210/205; 210/223; 210/243; 210/265; 210/275; 210/278; 210/279; 210/289; 210/484; 210/490; 210/493.1; 210/493.5; 204/228; 204/240; 204/639; 204/663; 204/664; 204/665

[58] Field of Search 210/748, 192, 210/198.1, 199, 202, 203, 205, 223, 243, 266, 275, 278, 279, 289, 291, 484, 490, 493.1, 493.5; 204/149, 152

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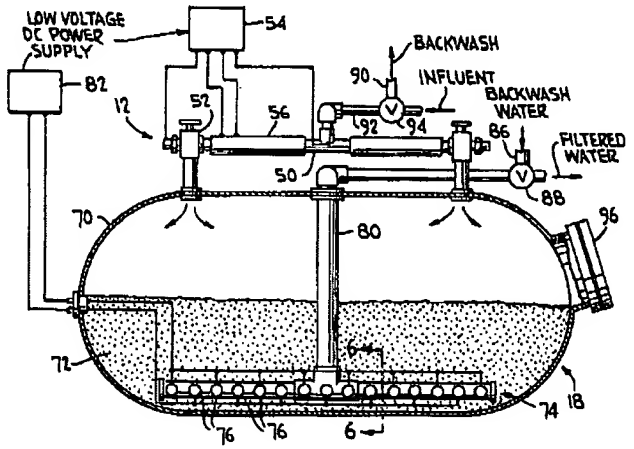
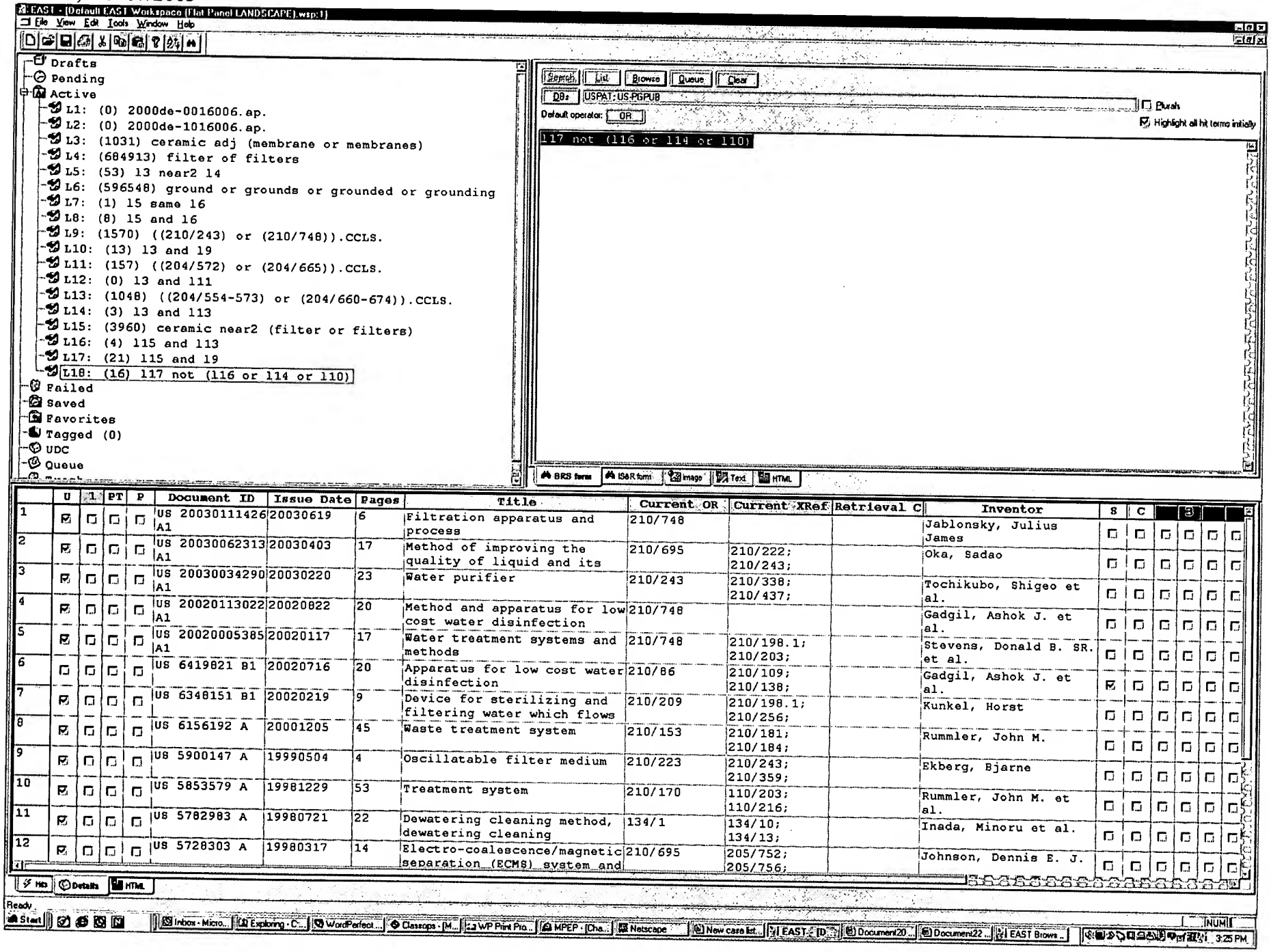
Primary Examiner—Peter A. Hruskoci
Attorney, Agent, or Firm—Michael de Angeli

[57] **ABSTRACT**

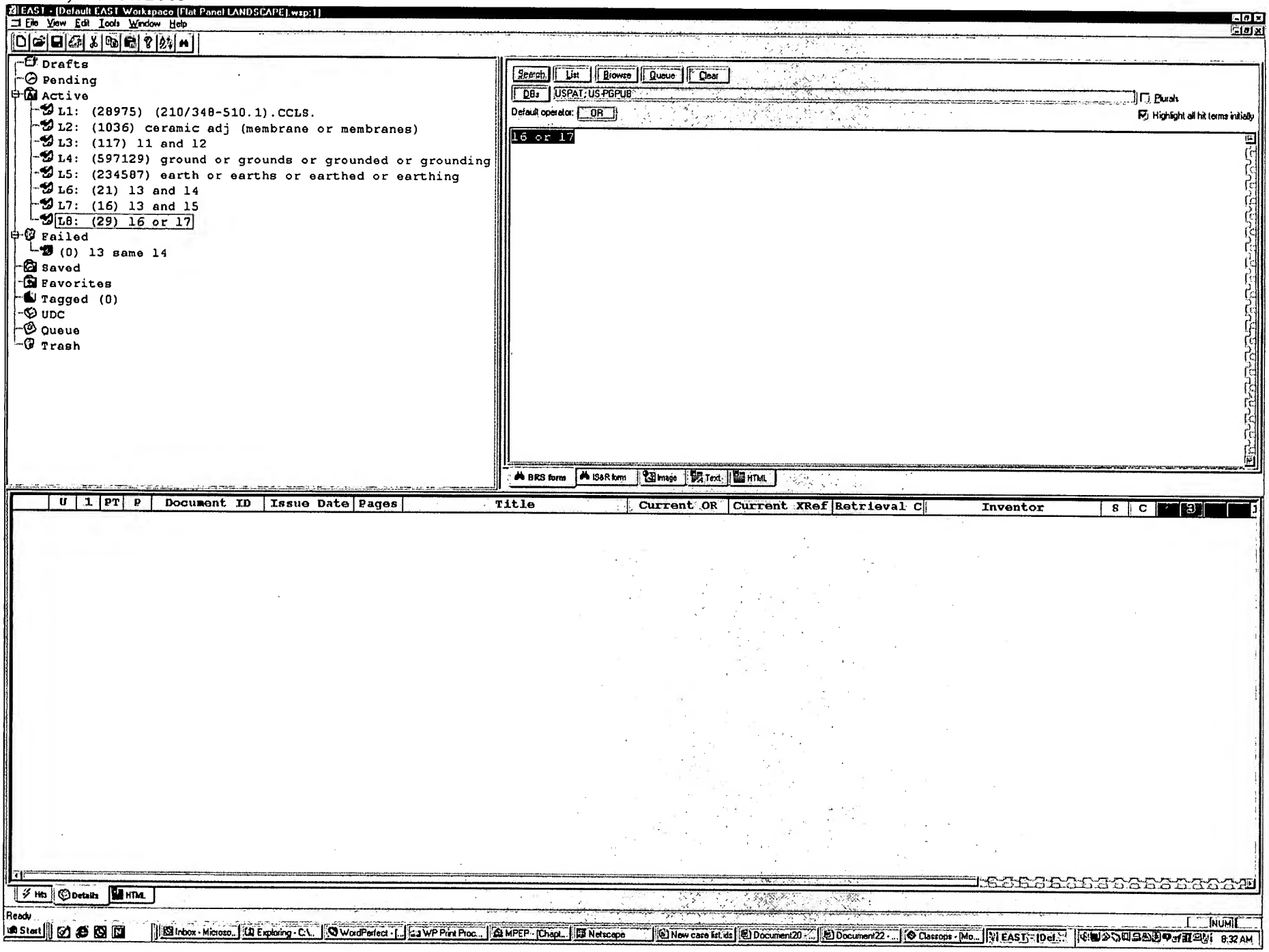
An improved electro-coalescent/magnetic separation (ECMS) system for removing contaminants from water, including desalinization, comprises a device for exposing a stream of water to be treated to an electric field, followed by introduction of ionized coagulating substances, including ionized gases and/or metal ions, followed by plural filter stages. The first filter stage may comprise a polarizable glass, alumina, or ceramic media provided as a bed in a tank with an underdrain, so as to provide substantial residence time. A polishing filter may comprise a very fine fiber or organic gel filter element confined between relatively flexible electrically-conductive screen members and provided with a DC power supply to polarize the filter. This assembly is confined between relatively rigid, perforated members such that the filter assembly can move slightly upon backwash to dislodge caked-on contaminants or the like, while preserving the structural integrity of the filter assembly.

63 Claims, 6 Drawing Sheets





	U	1	PT	P	Document ID	Issue Date	Pages	Title	Current OR	Current XRef	Retrieval C	Inventor	S	C	3
1	☑	☐	☐	☐	US 20030111426 A1	20030619	6	Filtration apparatus and process	210/748			Jablonsky, Julius James	☐	☐	☐
2	☑	☐	☐	☐	US 20030062313 A1	20030403	17	Method of improving the quality of liquid and its	210/695	210/222; 210/243;		Oka, Sadao	☐	☐	☐
3	☑	☐	☐	☐	US 20030034290 A1	20030220	23	Water purifier	210/243	210/338; 210/437;		Tochikubo, Shigeo et al.	☐	☐	☐
4	☑	☐	☐	☐	US 20020113022 A1	20020822	20	Method and apparatus for low cost water disinfection	210/748			Gadgil, Ashok J. et al.	☐	☐	☐
5	☑	☐	☐	☐	US 20020005385 A1	20020117	17	Water treatment systems and methods	210/748	210/198.1; 210/203;		Stevens, Donald B. SR. et al.	☐	☐	☐
6	☐	☐	☐	☐	US 6419821 B1	20020716	20	Apparatus for low cost water disinfection	210/86	210/109; 210/138;		Gadgil, Ashok J. et al.	☑	☐	☐
7	☑	☐	☐	☐	US 6348151 B1	20020219	9	Device for sterilizing and filtering water which flows	210/209	210/198.1; 210/256;		Kunkel, Horst	☐	☐	☐
8	☑	☐	☐	☐	US 6156192 A	20001205	45	Waste treatment system	210/153	210/181; 210/184;		Rummler, John M.	☐	☐	☐
9	☑	☐	☐	☐	US 5900147 A	19990504	4	Oscillatable filter medium	210/223	210/243; 210/359;		Ekberg, Bjarne	☐	☐	☐
10	☑	☐	☐	☐	US 5853579 A	19981229	53	Treatment system	210/170	110/203; 110/216;		Rummler, John M. et al.	☐	☐	☐
11	☑	☐	☐	☐	US 5782983 A	19980721	22	Dewatering cleaning method, dewatering cleaning	134/1	134/10; 134/13;		Inada, Minoru et al.	☐	☐	☐
12	☑	☐	☐	☐	US 5720303 A	19980317	14	Electro-coalescence/magnetic separation (ECMS) system and	210/695	205/752; 205/756;		Johnson, Dennis E. J.	☐	☐	☐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L2: (1036) ceramic adj (membrane or membranes)
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L4: (597129) ground or grounds or grounded or grounding
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L6: (21) l3 and l4
L7: (16) l3 and l5
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3	US 6524421 B1	11				☑				USPAT
4	US 6355093 B1	21				☑				USPAT
5	US 6331248 B1	18				☑				USPAT
6	US 6225246 B1	26				☑				USPAT
7	US 6214757 B1	34				☑				USPAT
8	US 6214227 B1	11				☑				USPAT

US-PAT-NO: 6214227

DOCUMENT-IDENTIFIER: US 6214227 B1

TITLE: Ceramic filter module

---------- KWIC ----------

Brief Summary Text - BSTX (5):
Organic membranes have hitherto been used as a filter in the field of the production of foods, chemicals and semiconductors. Since, however, the organic membranes have poor heat resistance, pressure resistance, and chemical resistance, filters made of porous ceramic membranes which are excellent in the above properties have been substituted for the organic membranes. The porous ceramic membranes have also been used as a catalyst carrier, a bioreactor such as a microorganism cultivation carrier, and the like.

Detailed Description Text - DETX (11):
This porous silicon nitride ceramic body is described in detail in Japanese Patent Application No. 500470/1995. Specifically, the porous silicon nitride ceramic body comprises a columnar silicon nitride having an aspect ratio of at least 3 as the main component, at least one rare earth element compound in an amount of 1 to 20% by volume in terms of oxide, and optionally at least one selected from the group consisting of compounds of group 2A and 3B elements of the periodic table and transition metal elements in an amount of at most 5% by volume in terms of oxide. In this case, at least 60% of all the silicon nitride particles are accounted for by .beta.-silicon nitride particles having an aspect ratio of at least 3.

Detailed Description Text - DETX (12):
The porous silicon nitride ceramic body can be prepared by a method which comprises: mixing an Si.sub.3 N.sub.4 powder with rare earth element compound powder(s) as the raw material and optionally other compound powder(s) together, molding the mixture by a conventional molding method, and heat-treating the molding in a nitrogen-containing inert atmosphere at a temperature of 1500 to 2100.degree. C. The density of the molding is preferably 30 to 60% of the theoretical density from the viewpoint of providing predetermined porosity and pore diameter. The average pore diameter can be regulated by the particle size of the raw material powders and the density of the molding.

Current US Original Classification - CCOR (1):
210/510.1

Current US Cross Reference Classification - CCXR (1):
210/433.1

(12) **United States Patent**
Park et al.

(10) **Patent No.: US 6,214,227 B1**
(45) **Date of Patent: *Apr. 10, 2001**

(54) **CERAMIC FILTER MODULE**

(75) Inventors: **Jin-Joo Park**; Chihiro Kawai, both of Itami (JP)

(73) Assignee: **Sumitomo Electric Industries, Ltd.**, Osaka (JP)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/134,605

(22) Filed: Aug. 14, 1998

(30) **Foreign Application Priority Data**

Aug. 20, 1997 (JP) 9-223939
Jul. 14, 1998 (JP) 10-198811

(51) Int. Cl.[7] B01D 39/00

(52) U.S. Cl. 210/510.1; 210/433.1; 55/523; 502/527.21; 502/527.18; 502/527.19; 501/97.1

(58) Field of Search 210/483, 488, 210/489, 490, 498, 506, 496, 510.1, 433.1, 502.1; 55/522, 523, 524; 502/527.11, 527.18, 527.19, 527.21, 200, 439; 501/97.1

(56) **References Cited**

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5,846,460 12/1998 Matsuura et al. .

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0 653 392 A1 5/1995 (EP) .
4-892 1/1992 (JP) .
4-893 1/1992 (JP) .
9-100179 4/1997 (JP) .
WO 94/27929 12/1994 (WO) .

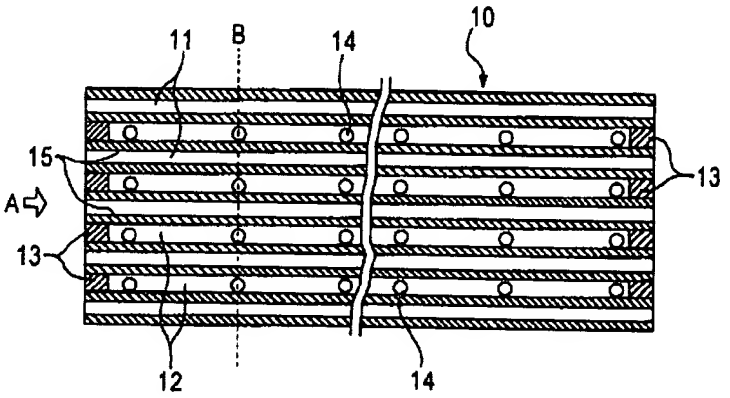
* cited by examiner

Primary Examiner—W. L. Walker
Assistant Examiner—Terry Cecil
(74) *Attorney, Agent, or Firm*—McDermott, Will & Emery

(57) **ABSTRACT**

A ceramic filter module includes a plurality of passage holes (11) and internal passage holes (12) alternately arranged about a plurality of ceramic partitions (15). The internal passage holes are sealed at each end by seals (13). The partitions are at most 1 mm thick and allow fluid to be filtered as the fluid flows from passage holes (11) to the internal passage holes (12). A plurality of discharge holes (14) traversing through the ceramic partitions between adjacent internal passage holes or between an internal passage hole and an outer surface allow the permeate to exit. The module is a porous ceramic body that preferably has an average pore diameter of 1 μm and is composed of silicon nitride. The ceramic filter module has the advantages of low permeation resistance and very high permeability.

4 Claims, 5 Drawing Sheets



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8	US 6214227 B1	11				☑				USPAT
9	US 6059970 A	7				☑				USPAT

US-PAT-NO: 6059970

DOCUMENT-IDENTIFIER: US 6059970 A

TITLE: Membrane separation device

---------- KWIC ---------

Brief Summary Text - BSTX (16):

The device of this invention is suitable for the testing of a variety of different burdened liquid materials (for example industrial waste water disposal, leach water, ground water, soil washing waste water, subterranean water, surface water, river water, etc.) and may find particular applicability in the following cases: petrochemical process water: 5% Chlopropanol and 1.8% HCL; technological waste water from chemical industry: 2.4% Chlorphenol, 5% NaCL; waste water from groung remediation or soil washing of military objectives: oil, detergent, residual-simulation after the employment of ABC weapons; waste water from regeneration processes of ion exchanger: mostly NaCL, salts at higher concentrations; processing of laundry waste water, and; galvenic waste water and rinse bath recycling: heavy metals ark H.sub.2 O.

Detailed Description Text - DETX (15):

For use in this device, membrane 6 may be any of the known membrane materials utilized for the particular testing operation (for example, polysulthone (PSO) UF or MF membranes, cellulose acetate RO, NF or UF membranes, thin film composite RO or NF membranes membranes (TFC or TFM, for example), PVDF membranes, PAN membranes, ceramic membranes, and the like). Spiral 8 may be made of synthetic foil material having a thickness of between about 0.2 to 2 mm (for example PVDF or PVA material). Spacer holder 10 is preferably made of a synthetic polymeric material (selected for compatibility with the tested medium) in a diamond, parallel or other spacer arrangement configuration.

Current US Cross Reference Classification - CCXR (4):
210/350

Current US Cross Reference Classification - CCXR (5):
210/354

Current US Cross Reference Classification - CCXR (6):
210/355

Current US Cross Reference Classification - CCXR (7):
210/359

Current US Cross Reference Classification - CCXR (8):
210/380.1

United States Patent [19]

Kohlheb et al.

[11] **Patent Number: 6,059,970**

[45] **Date of Patent: May 9, 2000**

[54] **MEMBRANE SEPARATION DEVICE**

[76] Inventors: **Robert Kohlheb**, Maisfeld 12, D-29336 Nienhagen, Germany; **Robert Rautenbach**, Wolfhaag 62, NL 6291 N Vaals, Netherlands

[21] Appl. No.: 09/013,740

[22] Filed: Jan. 27, 1998

[30] **Foreign Application Priority Data**

Jan. 28, 1997 [DE] Germany 197 02 902

[51] **Int. Cl.**[7] **B01D 63/00**

[52] **U.S. Cl.** 210/321.6; 210/321.78; 210/323.2; 210/359; 210/380.1; 210/350; 210/354; 210/355; 210/331

[58] **Field of Search** 210/323.2, 324, 210/359, 364, 355, 356, 380.1, 321.6, 350, 354, 416, 413, 331, 407, 321.78

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,308,142	12/1981	Braukmann et al.	210/355
4,655,911	4/1987	Tabor	210/354
4,702,842	10/1987	Lapierre	210/651
4,795,570	1/1989	Young	210/355

FOREIGN PATENT DOCUMENTS

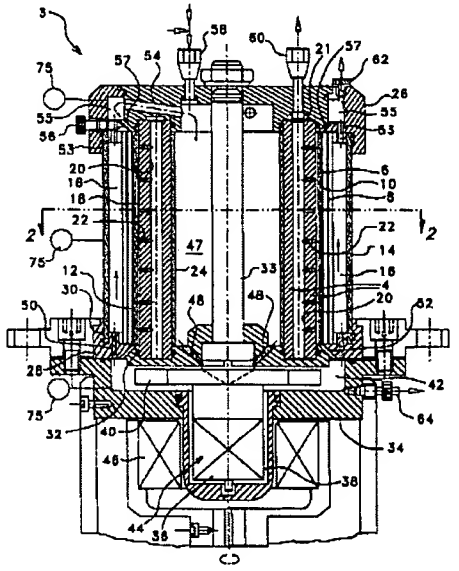
0448466	9/1991	European Pat. Off. .	
0605826	7/1994	European Pat. Off. .	
2420728	11/1974	Germany .	
4143423C2	10/1992	Germany .	

Primary Examiner—Ana Fortuna
Attorney, Agent, or Firm—Harold A. Burdick

[57] **ABSTRACT**

A membrane separation device is disclosed having a cylindrical membrane support (4), which is sealed off between a top plate (26) and a bottom plate (28), whereon the cylindrical outer surface of the membranes support a membrane (6) is located, and which is surrounded by cylindrical components (14, 8) which are sealed off in the top plate and bottom plate thereby forming a cylindrical ring area (16). Permeate collection bores (20) communicate with the membrane through the membrane support and are connected with a permeate draw off connection (60). The suction side of a circulation pump (44) is connected with an enclosed inner chamber (47) formed by the cylindrical membrane support. The outer ring area is connected to the pressure side of the circulation pump and communicates with the inner chamber through a circulation channel (54). The inner chamber is connected to a infeed connection (58). The circulation pump communicates with a draw off (64) on the pressure side for the extraction of concentrate.

20 Claims, 2 Drawing Sheets



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9	US 6059970 A	7				☑				USPAT
10	US 6033632 A	32				☑				USPAT
11	US 5976324 A	6				☑				USPAT
12	US 5779904 A	20				☑				USPAT
13	US 5753121 A	15				☑				USPAT

Background

Brief Summary Text - BSTX (3):

Also known are so-called ceramic membranes composed substantially of inorganic materials, which, compared with polymer membranes, have the advantage that they are resistant to high temperatures, so that regeneration is possible, and moreover are relatively inert. Such membranes are usually produced starting from multi-layered systems, in which a relatively thick macroporous layer serves as a support for a microporous top layer which is much thinner relative to the supporting layer and exhibits the separation properties. The production of such membranes, in which the so-called sol-gel or dip-coating techniques can be used successfully for providing the separating layer, is described inter alia in the following publications: A. Larbot, A. Julbe, C. Guizard, L. Cot, J.Membr.Sci., 93, (1989), 289-303; A. Larbot, J.P. Fabre, C. Guizard, L. Cot, J.Am.Ceram.Soc., 72, (1989), 257-261; W.A. Zeltner, M.A. Anderson, "Chemical Control over Ceramic Membrane Processing: Promises, Problems and Prospects", in: Proc. 1st Int.Conf.Inorg.Membr., (eds. J. Charpin, L. Cot), Montpellier, France, Jul. 3-6, 1989, 213-223; A. Leenaars, Preparation, Structure and Separation Characteristics of Ceramic Alumina Membranes, PhD thesis, University of Twente, Netherlands, (1984); H.M. van Veen, R.A. Terpstra, J.P.B.M. Tol, H.J. Verings, "Three-Layer Ceramic Alumina Membrane for High Temperature Gas Separation Applications", in: Proc. 1st Int.Conf.Inorg.Membr., (eds. J. Charpin, L. Cot), Montpellier, France, Jul. 3-6, 1989, 329-335.

Brief Summary Text - BSTX (4):

A disadvantage of such ceramic membranes is that the separation efficiency is low. In most ceramic membranes developed so far, separation takes place on the basis of Knudsen diffusion. In that case, the rate of transport is inversely proportional to the square root of the molecular weight. The selectivity of the separation process is sufficient only if molecules having widely divergent molecular weights are to be separated from each other.

Brief Summary Text - BSTX (5):

Improved insights have led to separation processes on the basis of ceramic membranes exhibiting material transport mechanisms other than Knudsen diffusion, such as surface diffusion or capillary condensation: R.J.R. Uhlhorn, "Ceramic Membranes for Gas Separation; Synthesis and Transport Properties", PhD thesis, University of Twente, Netherlands, (1990). In the case of surface diffusion, use is made of differences in chemical and/or physical properties of the molecules to be separated. The surface of the separating (or active) part of the membrane is modified in such a manner that one type of molecule is transported much more rapidly than the other as a result of a difference in surface diffusion. However, the insight into the mechanism of surface diffusion is still poor, so that it is difficult to make appropriate use of differences in chemical and/or physical properties.

Brief Summary Text - BSTX (7):

Another drawback of the known ceramic membranes is that the pore size distribution is hard to control. Because the pores of the active layer are not uniform in size and shape, it is not possible to have such a membrane function as a molecular sieve. It has moreover been found to be very difficult to prepare a microporous layer that is stable under process conditions.

United States Patent [19]

Geus et al.

[11] Patent Number: 5,753,121

[45] Date of Patent: *May 19, 1998

[54] **INORGANIC COMPOSITE MEMBRANE COMPRISING MOLECULAR SIEVE CRYSTALS**

[75] Inventors: **Edward Rudolf Geus**, Bilthoven; **Jacobus Cornelis Jansen**; **Blandinus Catharinus Jaspers**, both of Delft; **Johannes Schoonman**, Wassenaar; **Herman van Bekkum**, Vlaardingen, all of Netherlands

[73] Assignee: **Exxon Chemical Patents Inc. (ECPI)**, Houston, Tex.

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,429,743.

[21] Appl. No.: **462,108**

[22] Filed: **Mar. 10, 1995**

Related U.S. Application Data

[63] Continuation of Ser. No. 98,287, filed as PCT/NL92/00029 Feb. 7, 1992, Pat. No. 5,429,743.

[30] **Foreign Application Priority Data**

Feb. 7, 1991 [NL] Netherlands 9100217

[51] Int. Cl.[6] **B01D 29/00**

[52] U.S. Cl. 210/490; 210/500.22; 210/500.25; 210/506; 264/45.5; 264/139; 502/4; 502/64; 502/71; 96/4; 96/11

[58] Field of Search 210/490, 500.25, 210/504, 500.22, 502.1; 264/45.1, 45.5, 139, 140; 502/4, 64, 71; 95/50, 54, 130; 96/4, 11; 428/688, 689

[56] **References Cited**

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5,069,794	12/1991	Haag et al.	210/651
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5,429,743	7/1995	Geus et al.	210/40

FOREIGN PATENT DOCUMENTS

0135069	3/1985	European Pat. Off. .
0460512	12/1991	European Pat. Off. .
2641631	3/1978	Germany .
3827049	2/1990	Germany .
60-129119	7/1985	Japan .

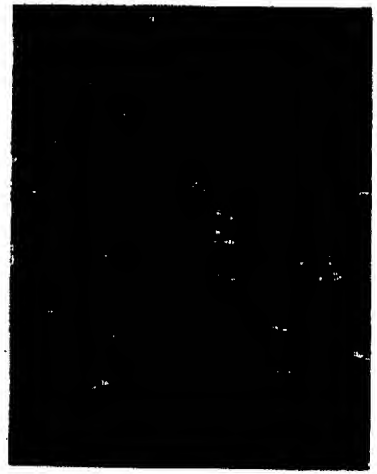
Primary Examiner—Ana Fortuna

Attorney, Agent, or Firm—Edward F. Sherer

[57] **ABSTRACT**

Inorganic composite membrane containing molecular sieve crystals, comprising a macroporous support to which molecular sieve crystals and modifications thereof have been applied substantially as a monolayer, said crystals and modifications thereof having been oriented so that, to a substantial extent, the pores of the sieve crystals form a significant included angle with the support surface, there being present between the crystals a gastight matrix, at least gastight to a degree sufficient under practical conditions.

33 Claims, 5 Drawing Sheets



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9	US 6059970 A	7							☑				USPAT
10	US 6033632 A	32							☑				USPAT
11	US 5976324 A	6							☑				USPAT
12	US 5779904 A	20							☑				USPAT
13	US 5753121 A	15							☑				USPAT
14	US 5611931 A	7							☑				USPAT

US-PAT-NO: 5611931

DOCUMENT-IDENTIFIER: US 5611931 A

TITLE: High temperature fluid separations using ceramic membrane device

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Abstract Text - ABTX (1):

A high temperature ceramic membrane device for separation of fluids at high temperature, the device comprises: (a) a housing having: (i) an entrance for introducing fluids to the housing to be separated, (ii) an exit for removing fluids after being subjected to separation; (b) a plate mounted in one end of the housing, the plate having openings therein; (c) ceramic membrane comprised of porous ceramic tubes having a closed end and an open end, the tubes permeable by a fraction of the fluid to be removed from the fluid as filtrate and impermeable to a second fraction, the open end designed to remove the filtrate from the tube, the tubes mounted in the openings in the plate so that the closed end is projected into the housing and the open end is extended outside the housing for removing the filtrate; (d) a seal for sealing the plate in the housing; (e) insulation provided in the housing, the insulation means located adjacent the plate and surrounding the tubes projecting therethrough, the insulation adapted to insulate the hot fluid in the housing from the plate; and (f) cooling outside the housing adjacent the seal to maintain the seal at a relatively low temperature.

TITLE - TI (1):

High temperature fluid separations using ceramic membrane device

Brief Summary Text - BSTX (2):

The present invention relates to high temperature separation of fluids using a ceramic membrane device and a method for separating fluids at high temperatures using a ceramic membrane device.

Brief Summary Text - BSTX (3):

Ceramic membranes have been widely used in liquid phase separations in pharmaceutical, food, beverage and other industries. Recently, they have also been tested for gas separations (Wu, J. C. S., et al, "High Temperature Separation of Binary Gas Mixtures Using Microporous Ceramic Membranes", J. Membrane Science, 77, 85 (1993)) and catalytic reactions (G. Saracco & V. Specchia, "Catalytic Inorganic Membrane Reactors, Present Experience and Future Opportunities", Cataly. Review - Sci. Eng., 36, 305 (1994)). Ceramic membranes have the advantage of improved thermal and chemical stability over polymeric membranes commonly used in industrial separations.

Brief Summary Text - BSTX (4):

The use of ceramic membrane tubes in the prior applications is set forth, for example, in F. M. Velterop et al, "Development of a High Temperature Resistant Module for Ceramic Membranes", Key Engineering Materials, 61 & 62, 391 (1991), wherein there is disclosed processes such as solid/liquid

United States Patent [19]

Liu et al.

[11] **Patent Number: 5,611,931**

[45] **Date of Patent: Mar. 18, 1997**

[54] **HIGH TEMPERATURE FLUID SEPARATIONS USING CERAMIC MEMBRANE DEVICE**

[75] Inventors: **Paul K. T. Liu**; **Hillary K. Sabol**, both of Pittsburgh; **Gerald W. Smith**, Harwick; **Richard J. Ciora, Jr.**, Butler, all of Pa.

[73] Assignee: **Media and Process Technology Inc.**, Pittsburgh, Pa.

[21] Appl. No.: **509,199**

[22] Filed: **Jul. 31, 1995**

[51] Int. Cl.[6] **B01D 61/00**

[52] U.S. Cl. 210/653; 210/651; 210/323.2; 210/500.25; 95/43; 95/45; 96/10

[58] Field of Search 210/323.2, 321.78, 210/321.79, 321.8, 321.87, 321.88, 321.89, 510.1, 500.25, 500.26, 650, 651, 653; 95/43, 45; 96/10; 228/121

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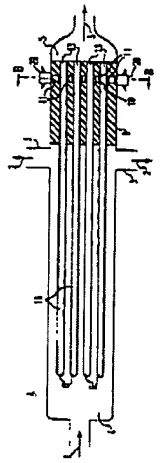
Primary Examiner—Ana Fortuna

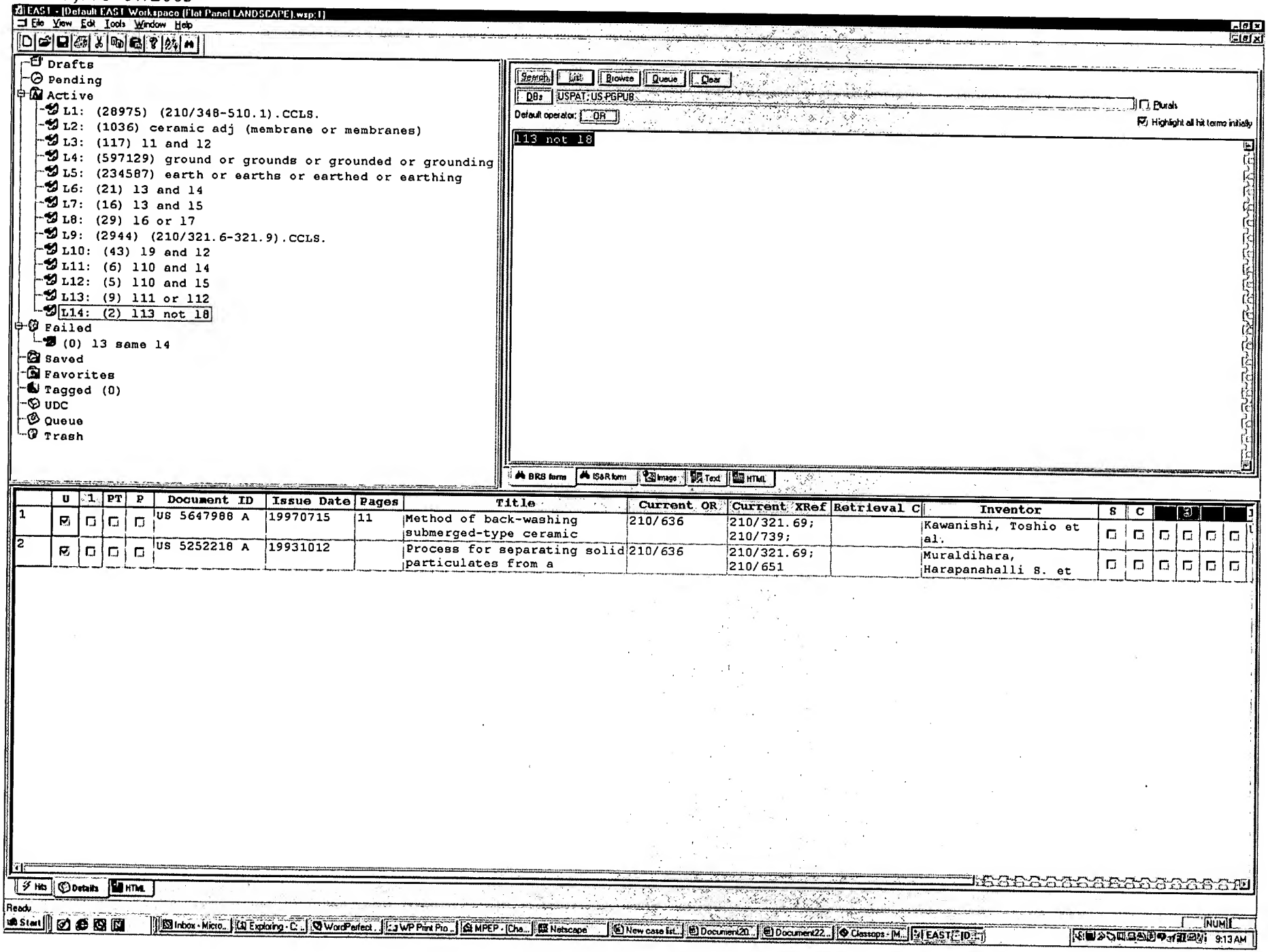
Attorney, Agent, or Firm—Andrew Alexander

[57] **ABSTRACT**

A high temperature ceramic membrane device for separation of fluids at high temperature, the device comprises: (a) a housing having: (i) an entrance for introducing fluids to the housing to be separated, (ii) an exit for removing fluids after being subjected to separation; (b) a plate mounted in one end of the housing, the plate having openings therein; (c) ceramic membrane comprised of porous ceramic tubes having a closed end and an open end, the tubes permeable by a fraction of the fluid to be removed from the fluid as filtrate and impermeable to a second fraction, the open end designed to remove the filtrate from the tube, the tubes mounted in the openings in the plate so that the closed end is projected into the housing and the open end is extended outside the housing for removing the filtrate; (d) a seal for sealing the plate in the housing; (e) insulation provided in the housing, the insulation means located adjacent the plate and surrounding the tubes projecting therethrough, the insulation adapted to insulate the hot fluid in the housing from the plate; and (f) cooling outside the housing adjacent the seal to maintain the seal at a relatively low temperature.

19 Claims, 1 Drawing Sheet

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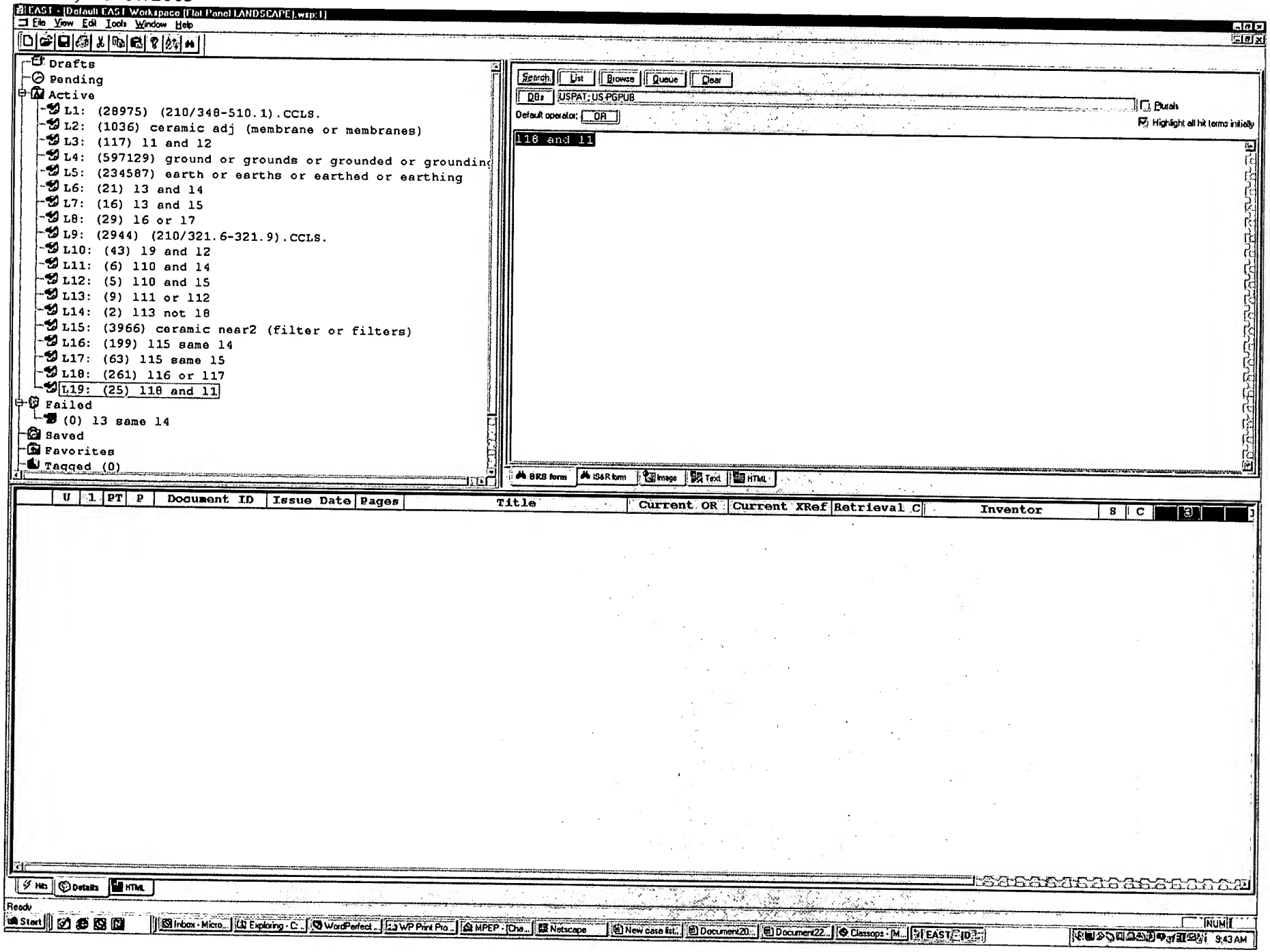
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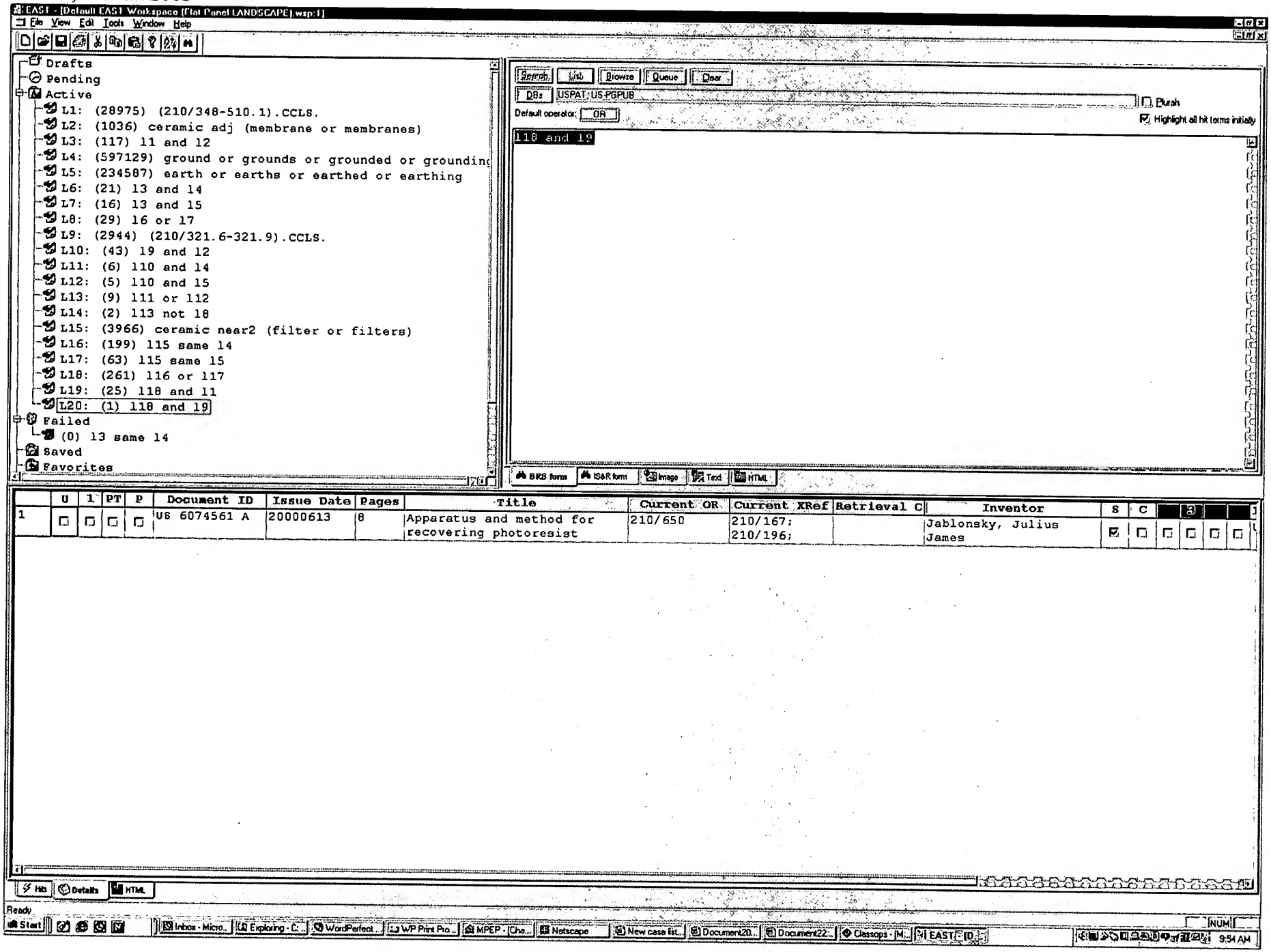
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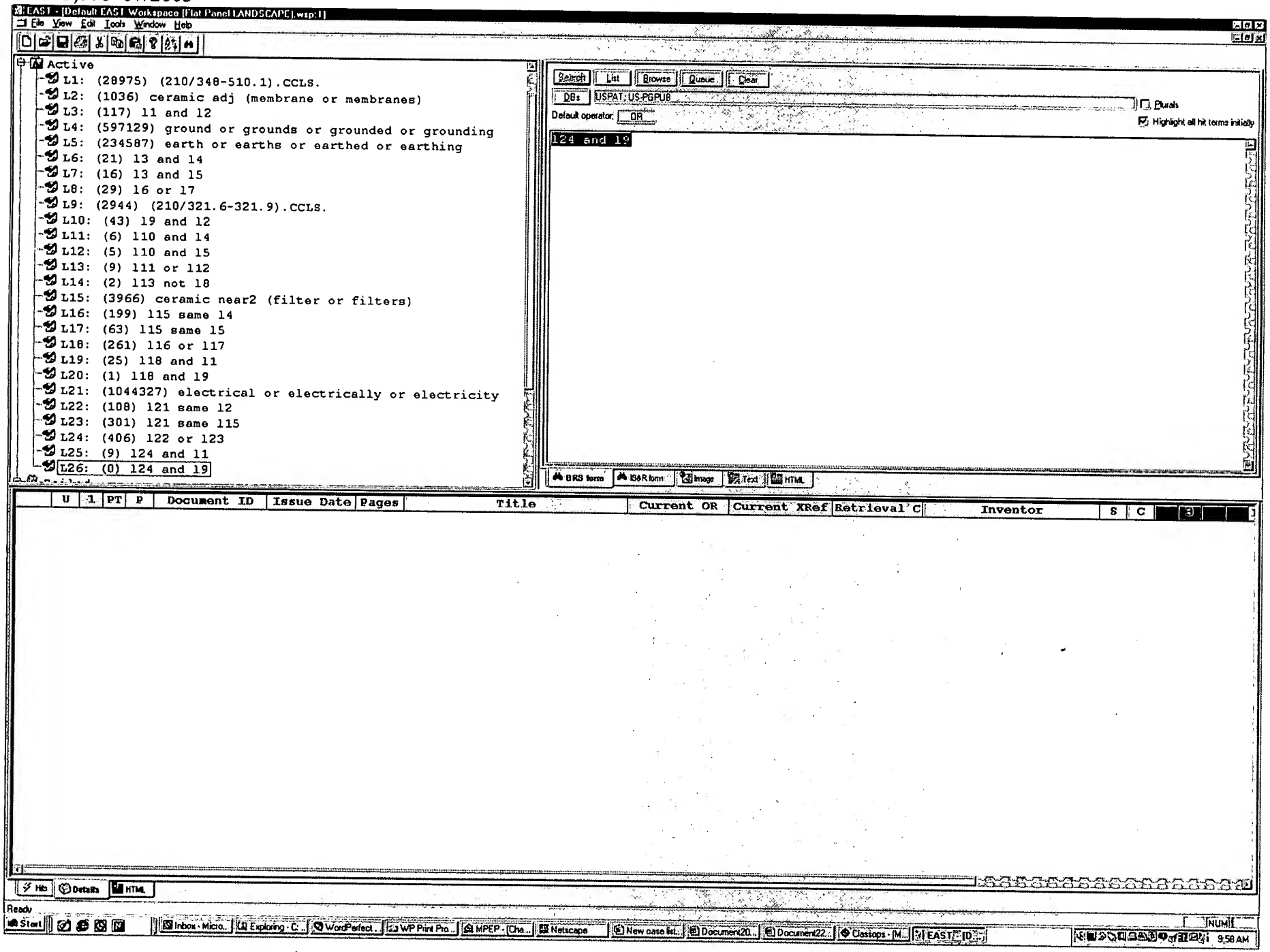
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US-PAT-NO: 6241878

DOCUMENT-IDENTIFIER: US 6241878 B1

TITLE: Self-purging in-line filter

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Abstract Text - ABTX (1):
Described is a self-cleaning filter for a liquid stream confined in a pipe 20. The filter includes a porous ceramic filter body 30 having a power source 35 attached thereto. Upstream from the filter body a helical rib 50 and a sump drain tube 42 are provided. In operation, as the filter becomes clogged, an electrical current is applied causing the ceramic body to exhibit ultrasonic transducer properties which dislodge particulates from its upstream face 31. At the same time, a sump valve 41 is opened to remove the particulate-rich liquid. The helical rib imparts a rotary motion which creates a rotary flow component across the upstream face of the filter.

Current US Cross Reference Classification - CCXR (3):
210/407

Current US Cross Reference Classification - CCXR (4):
210/456

Current US Cross Reference Classification - CCXR (5):
210/459

Current US Cross Reference Classification - CCXR (6):
210/510.1

(12) **United States Patent**
Snaper

(10) **Patent No.: US 6,241,878 B1**
(45) **Date of Patent: Jun. 5, 2001**

(54) **SELF-PURGING IN-LINE FILTER**

(76) Inventor: **Alvin A. Snaper**, 2800 Cameo Cir., Las Vegas, NV (US) 89107

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/518,017

(22) Filed: Mar. 3, 2000

(51) Int. Cl.[7] B01D 35/06

(52) U.S. Cl. 210/99; 210/106; 210/306; 210/407; 210/456; 210/459; 210/510.1

(58) Field of Search 210/99, 106, 243, 210/306, 320, 321.69, 785, 407, 408, 446, 510.1, 384, 388, 456, 459

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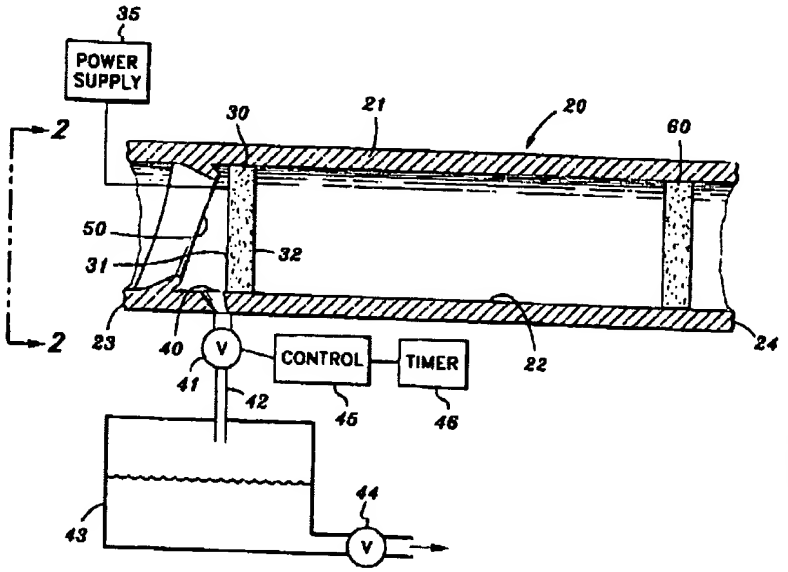
Primary Examiner—Joseph W. Drodge
Assistant Examiner—Terry K. Cecil
(74) *Attorney, Agent, or Firm*—Donald D. Mon

(57) **ABSTRACT**

Described is a self-cleaning filter for a liquid stream confined in a pipe 20. The filter includes a porous ceramic filter body 30 having a power source 35 attached thereto. Upstream from the filter body a helical rib 50 and a sump drain tube 42 are provided. In operation, as the filter becomes clogged, an electrical current is applied causing the ceramic body to exhibit ultrasonic transducer properties which dislodge particulates from its upstream face 31. At the same time, a sump valve 41 is opened to remove the particulate-rich liquid. The helical rib imparts a rotary motion which creates a rotary flow component across the upstream face of the filter.

5 Claims, 1 Drawing Sheet



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